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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Coating Apparatus

We, THE MEAD CORPORATION, a corporation duly organized and existing under the laws of the State of Ohio, United States of America, of 118 West First Street, Dayton, State of Ohio, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to coating machines for applying smooth coatings to moving webs of paper, paperboard and other fibrous webs during continuous relatively high speed coating operations. More particularly, this invention relates to novel apparatus for controlling turbulence and concomitantly maintaining adequate agitation in a pool of fluid coating composition during such coating operations.

Due to the increasing demand for coated papers, emphasis has been placed on developing types of coating equipment which can be used at relatively high speeds. A particular type of coater which has been used commercially is the blade coater. In this type coater, the metering and distribution of the fluid coating are accomplished by means of a flexible blade operating under pressure against the paper web moving over a backing roll. A pool of coating is formed in the area between the blade coating head and the moving paper web. At slow operating speeds, the coating in the pool has a slow rolling motion imparted to it by the movement of the paper web which forms one wall of the pool. As the coating speed is increased, the pool becomes more and more violently agitated until ridges appear on the surface of the pool, bubbles due to entrained air appear in the coating, and some splashing of the fluid coating may be observed. The speed at which these traits occur depends on the rheological properties of the coating, the temperature of the coating, the blade coater head geometry and the depth of the coating in the pool.

In the development of this invention, it was determined that proper control of the turbulence in the coating pool substantially eliminates certain referred to hereinafter problems which ordinarily cause defects in the resultant coated paper. One of the most acute of these problems concerns the control of the coating pool level, because the depth of the pool effects the coat weight applied. And if the pool depth is properly controlled, it can function as a means for controlling coat weight. In this connection, the use of a conventional coating level controller provided with a sensing element is deficient because such a controller is dependent on a relatively quiet coating surface to operate efficiently. Thus, when a coating pool is violently agitated as is the case during most commercial oprations, such a coating level control continually goes on and off with little relationship to the actual coating pool level. Coating also splashes onto the sensing element of the controller and in accumulating thereon, changes the control point with consequent coat weight irregularity. This results in broad fluctuations in coating pool level and corresponding fluctuations in coat weight.

Turbulence under some conditions of geometrical flow, poses the problem of entrapping air into the coating. The presence of this entrapped air apparently causes a condition which has been referred to as "stalactiting". The stalactites consist of elongated strings of partially dried coating hanging down from the back side of the blade. It is theorized that they are formed by the rupture of air bubbles after they have passed the blade. The stalactites cause fine streaks to occur in the coated sheet and under the worst conditions cause coating spots on the web.

The distribution of the coating on the paper web is affected by the turbulence of the coating pool. The higher the coat weight applied, the more significant is its influence over the coating distribution. In a tightly wound roll, heavy coating streaks 1/4 inch to 1/2 inch wide have been known to cause splitting of the coated paper in the machine direction after

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supercalendering. The heavy streaks correspond to the high levels in the coating pool and result in localized higher coat weights due to the increased dwell time of the coating on the web and in some measure, to the higher hydraulic pressure on the blade in those areas. Highly turbulent circulation of the coating will also cause air to be drawn into the pool, such that the coater blade is actually exposed to view. This results in uncoated areas. Lesser air entrapment results in areas of low coat weight.

Scumming is another problem which has been encountered in relatively high speed coating operations. The scum generally is located at the back edge of the coating pool, next to the coating head. This usually occurs when the coating next to the back of the coating head is not agitated. This also can occur with a highly turbulent coating pool if the geometric flow of the fluid coating creates a dead spot on its surface. The coating dries, scums and when it extends far enough over the pool where agitated coating can pull it away, follows the flow of the coating toward the web and passes the blade as a coating lump. This appears on the sheet as a relatively thin coating deposit about 11/16-15/16 inches across and conceivably could smash a printing plate.

Heretofore, many attempts have been made to solve and/or correct the above noted problems and deficiencies. For example, the use of a baffle device on a blade coater has been suggested for diverting the outward flow of a coating in a blade coater from the normal path of the coating along the surface of the doctor and partially directing the coating toward the center of the pool before it reaches the surface thereof.

The principal objection to such a device is that it cannot be removed, replaced, or adjusted without interrupting the coating operation, and since this type coater is frequently used in tandem with a paper machine, paper made during the period of adjustment would have to be discarded.

Accordingly, it is an object of the present invention to overcome the above-noted deficiencies by providing coating machines and apparatus for applying a smooth coating essentially free from streaks, skips and color spots to paper at higher than normal coating speeds.

It is another object of this invention to provide a device for controlling turbulence while concomitantly maintaining adequate agitation in a fluid coating pool, which device may be quickly adjusted to changing coating conditions without interrupting the coating process.

Other objects and advantages of the invention will become apparent from a consideration of the following description with reference to the accompanying drawings wherein:

Figure 1 is a fragmentary schematic diagram, explanatory of preferred apparatus for practicing the invention with a blade coater and illustrates the circulation of the coating in the pool;

Figure 2 is a top plan view taken on line 2—2 of Figure 1; and

Figure 3 is a fragmentary, schematic diagram of the color pond of Figure 1 showing modified positions of the apparatus of this invention for controlling agitation of the coating in the color pond.

Referring to the drawing, a paper web 10 is carried on the surface of backing roll 11 moving in the direction indicated by the arrows and into coatact with a pool 12 of fluid coating composition. The excess coating is removed by doctor blade 13, and the paper web 10 with the metered and smoothed coating is carried to suitable drying means. The blade 13 is clamped by means of a blade holder 14, to the coating head 15.

Movement of the paper web 10 through the pool 12 imparts circulatory movement to the fluid coating as indicated by the arrows. At very high speeds, and without utilizing a suppressor bar 16 of this invention, the uncontrolled turbulence caused by this circulatory movement is sufficient to cause defects to appear in the resultant coated paper.

Suppressor bar 16 preferably embodies a one inch metal pipe which is immersed in the coating pool 12 and is supported at each of its ends by a rod 17. Each rod 17 is supported by a clamp 18 which in turn is supported by the coating head 15. The rods 17 holding the suppressor bar 16 are adjustable up and down with respect to the clamp 18, and the clamp 18 is adjustable in and out with respect to the coating head 15. Adjustments are made by loosening the cap screws 19, 20 on the clamp 18. It can be seen from Figures 2 and 3 that the suppressor bar 16 can be readily positioned at nearly any spot in the coating pool 12, for example, at positions a, b, c or d as shown in Figure 3, to control turbulence to the desired degree of agitation in the coating pool 12. Positioning of suppressor bar 16 is readily determined by persons skilled in this art and such positioning is dependent on the degree of agitation desired. However, as determined by commercial operating conditions, the suppressing action increases as the bar 16 is moved toward the roll 11 as for example, from position c to position a, and decreases as it is moved from position a to positions b, c or d, away from roll 11.

The suppressor 16 of this invention could be solid as well as bored, and the cross section of the bar could be square, oblong, flattened, or pear-shaped as shown by Figures 4-6 and indicated by 16, 16^{11} and 16^{111} without departing from the scope of this invention. The bar 16 also could be constructed of materials other than metal, e.g., of plastic or hard rubber.

One advantage of a bored suppressor bar, such as a pipe, is that hot or cold fluids can be circulated through the suppressor to help maintain the desired temperature of the coating. Both steam and cooling water have been used successfuly in carrying out this invention in a commercial installation. One obvious simple arrangement for circulating hot or cold fluids through the disclosed pipe form of the suppressor bar 16 would be to make the support rods tubular with their bores communicating with the ends of the bore in the suppressor bar 16. The ends of the bar 16 could be capped in conventional manners and flexible fluid conduits, not shown, could be coupled in conventional manner to the upper ends of the tubular support rods 17.

It has been found that the use of the device of this invention provides effective control of turbulence at coater speeds of the order of 1700 feet per minute on a commercial blade coater. Moreover, it is recognized that turbulence at even higher speeds can be readily controlled by the proper use of the suppressor of this invention as shown in Figure 3 of the drawing which illustrates that the suppressor 16 is adjustable in various positions with respect to the back-up roll 11.

WHAT WE CLAIM IS:—

1. A paper coating device, comprising a doctor mounted in position for one edge thereof to contact a paper web on the surface of a continuously rotatable paper-web-carrying roll to form an angular bight adapted to maintain a pool of liquid coating composition in contact with said paper web immediately in advance of its passage under the doctor, wherein a suppressor bar is positioned longitudinally of and submerged in said pool in spaced relation to the boundary surfaces thereof and supported by rod means extending upwardly through the free surface of the pool and having relatively small cross-sectional area as compared to that of the suppressor bar so as to minimize the effect of said rod means on the turbulence of the pool, whereby turbulence in the pool is suppressed by fluid friction forces associated with the suppressor bar.

2. A paper coating device according to claim 1, wherein the rod means are adjustable for varying the position of the suppressor bar in the pool.

3. A paper coating device according to claim 1 or 2, wherein the suppressor bar is bored through its length to allow passage of fluid materials for controlling the temperature of the coating pool.

4. A paper coating device according to claim 1, 2 or 3, wherein the suppressor bar is circular in cross-section.

5. A paper coating device according to claim 1, 2 or 3, wherein the suppressor bar is elliptical in cross-section.

6. A paper coating device according to claim 1, 2 or 3, wherein the suppressor bar is flat in cross-section.

7. A paper coating device according to claim 1, 2 or 3, wherein the suppressor bar is pear-shaped in cross-section.

8. A paper coating device, substantially as described with reference to the accompanying drawing.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 1

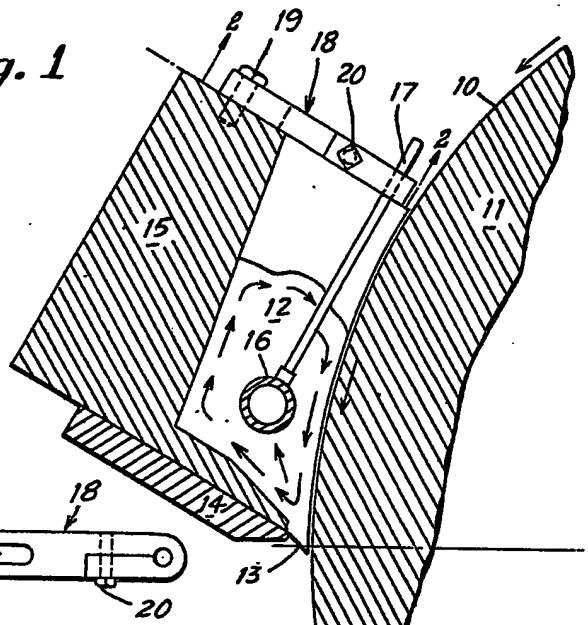

Fig. 2

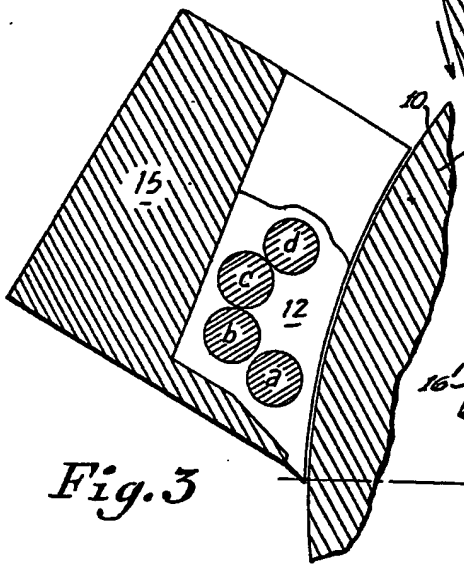

Fig. 3

Fig. 4 Fig. 5.

Fig. 6.